Improving Both

Safety
and
Productivity

At the Same Time

Presentation to: Idaho National Laboratory

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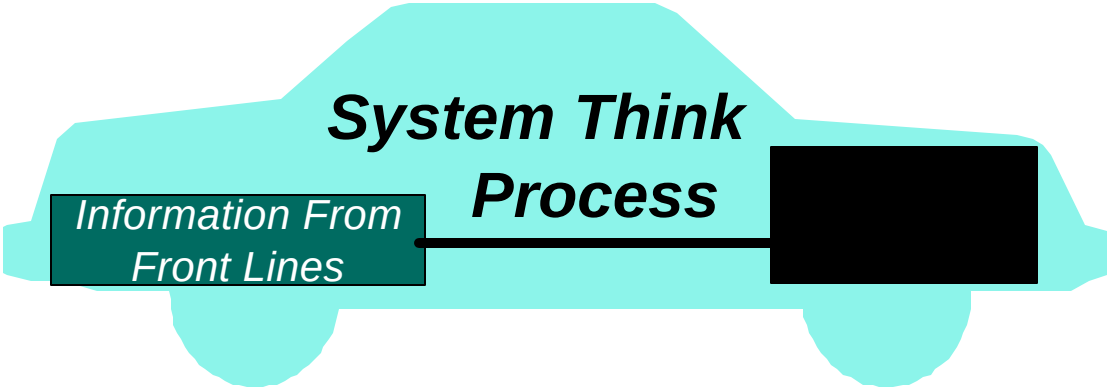
Date: August 28, 2008

Federal Aviation Administration

Outline

- The Context
- Importance of Better Information
- Importance of “System Think”
- Safety Benefits
- Productivity Benefits
- Aviation Successes and Failures
- The Role of Leadership

Process Plus Fuel Can Produce An Amazing Win-Win



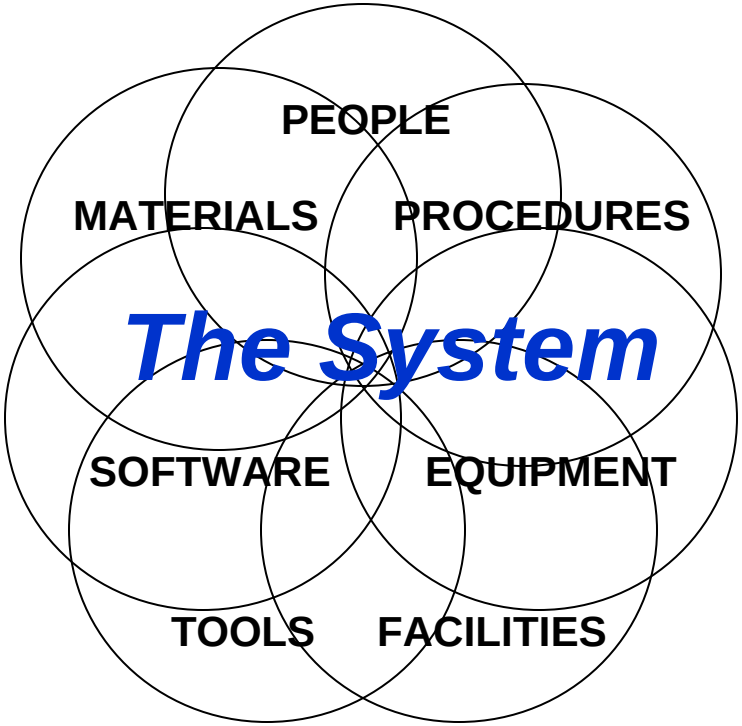
Improved *Safety*

AND

Improved *Productivity*

The Context: Increasing Complexity

- **More System *Interdependencies***
  - Large, complex, interactive system
  - Tightly coupled
  - Hi-tech components
  - Continuous innovation
- ***Safety Issues More Likely to Involve Interactions Between Parts of the System***



Effects of Increasing Complexity:

More "Human Error" Because

- System More Likely to be Error Prone
- Operators More Likely to Encounter Unanticipated Situations
- Operators More Likely to Encounter Situations in Which "By the Book" May Not Be Optimal ("workarounds")

The Result:

Front-Line Staff Who Are

- Highly Trained

- Competent

- Experienced,

-Trying to Do the Right Thing, and

- Proud of Doing It Well

. . . Yet They Still Commit

Inadvertent

Human Errors

When Things Go Wrong

How It Is Now . . .

You are highly trained

and

If you did as trained, you would not make mistakes

so

You weren't careful enough

so

You should be PUNISHED!

How It Should Be . . .

You are human

and

Humans make mistakes

so

Let's *also* explore why the system allowed, or failed to accommodate, your mistake

and

Let's IMPROVE THE SYSTEM!

Fix the Person or the System?

Is the Person *Clumsy?*

Or Is the Problem . . .

The *Step???*

Enhance Understanding of Person/System Interactions By:

- Collecting,

- Analyzing, and

- Sharing

Information

Two Objectives:

Make the System

Less

Error Prone

and

More

Error Tolerant

The Health Care Industry

To Err Is Human:

Building a Safer Health System

"The focus must shift from blaming individuals for past errors to a focus on preventing future errors by designing safety into the system."

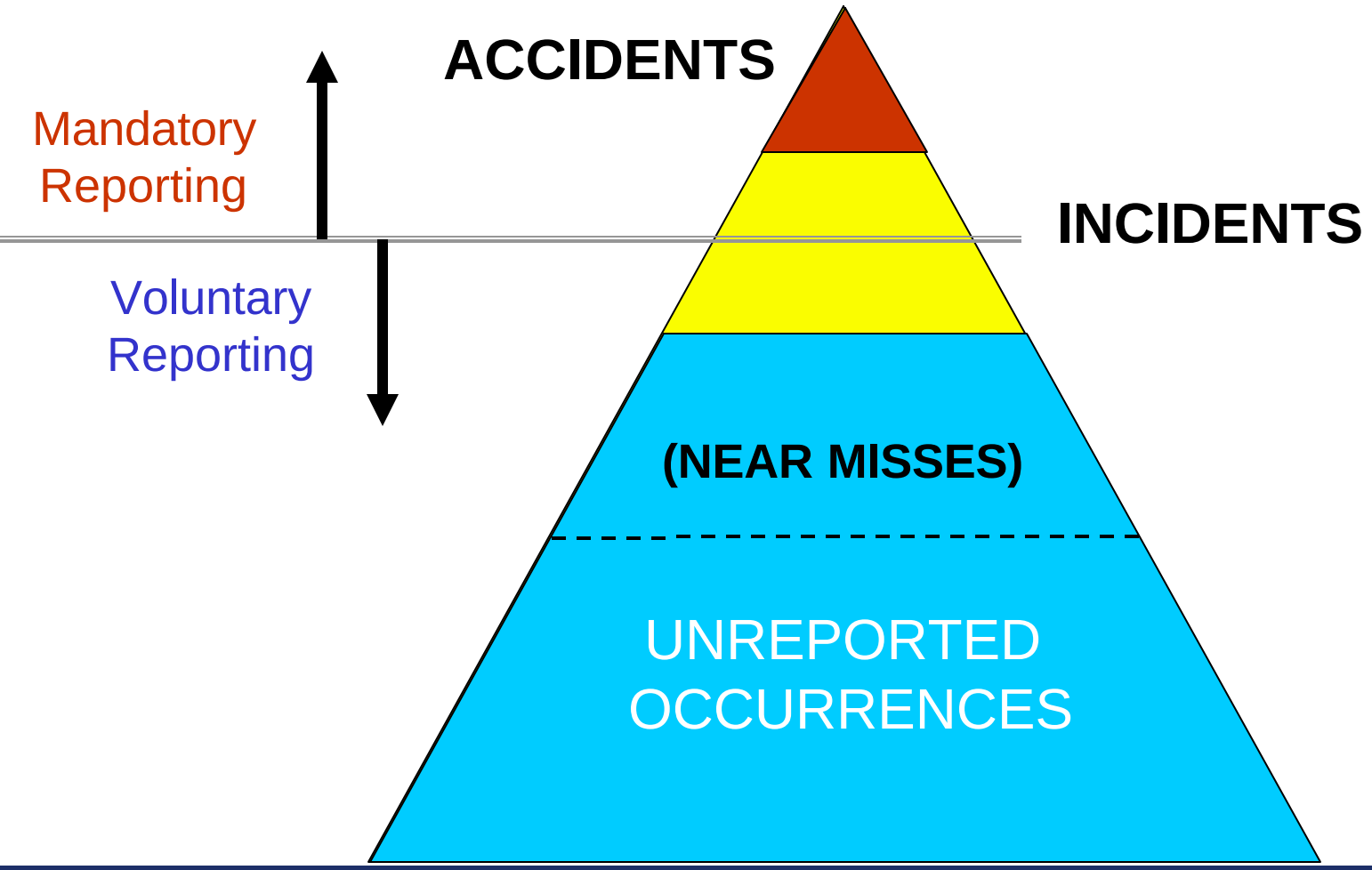
Institute of Medicine, Committee on Quality of Health Care in America, 1999

Current System Data Flow

Almost all Data is Lost Forever

Currently Only a Minute Portion of Data is Collected and Analyzed

Heinrich Pyramid



Major Source of Information: Hands-On "Front-Line" Employees

"We Knew About That Problem"

(and we knew it might hurt someone sooner or later)

Legal Concerns That Discourage Collection, Analysis, and Sharing

- **Public Disclosure**
- **Job Sanctions and/or Enforcement**
- **Criminal Sanctions**
- **Civil Litigation**

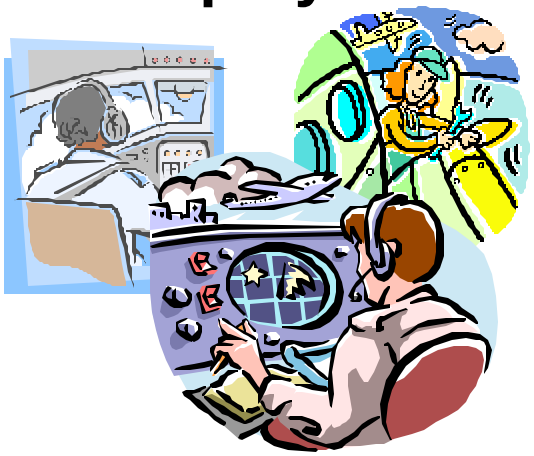
Typical "Cultural" Barrier

"Safety First"

Middle Management

"Production First"

Front-Line Employees



"Please the Boss First…
THEN Consider Safety?"

Creating a "Just Culture"

Objective is not to *DECREASE*

the safety accountability

of the *OPERATOR* . . .*

but to . . .

***INCREASE* the safety accountability**

of everyone who designs, builds, manages, maintains, and regulates

the *SYSTEM*

i.e., NOT "Non-Punitive" or "Get Out of Jail Free"

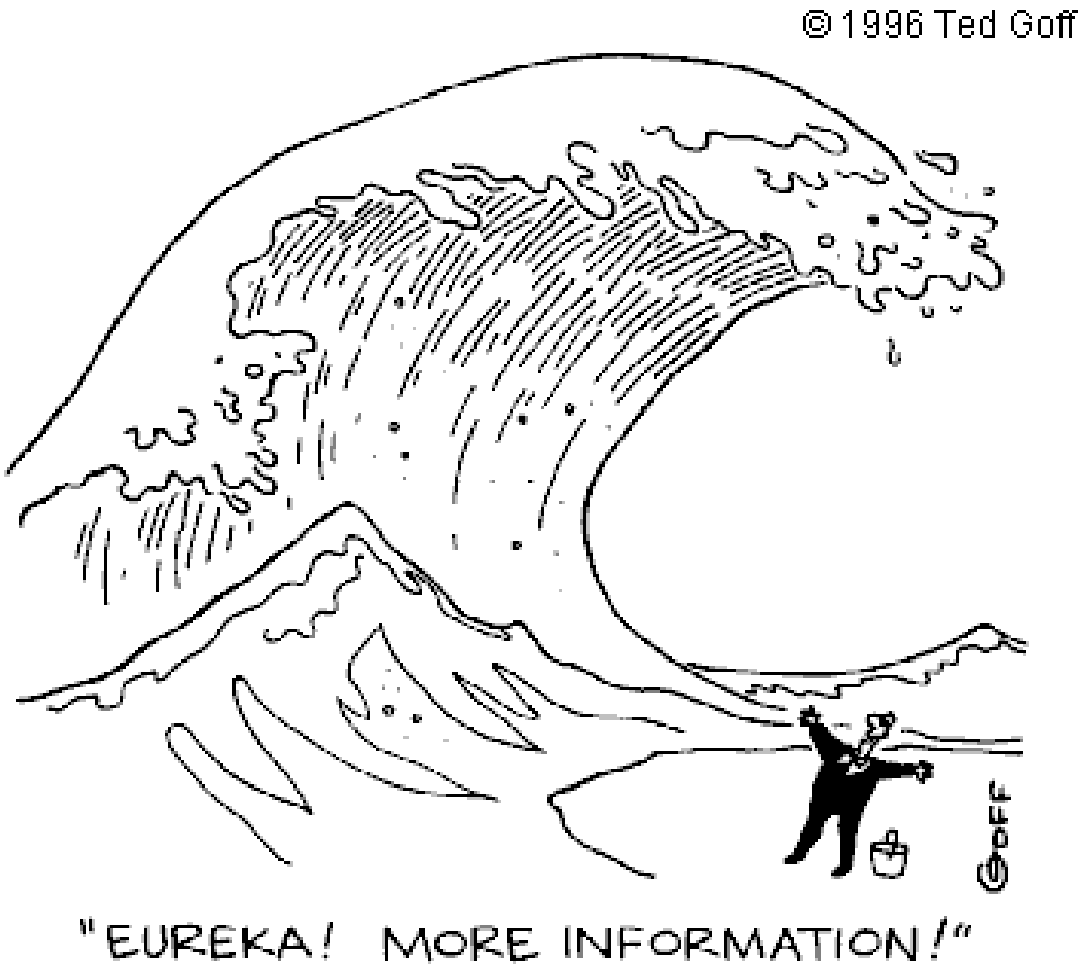
Next Challenge

Legal/Cultural Issues

Improved Analytical Tools

As we begin to get over the first hurdle, we must start working on the next one . . .

Information Overload



From Data to Information

Tools and processes to convert large quantities of data into useful information

Data Sources

Info from front line staff and other sources

DATA

Analysts

Tools

Processes

USEFUL

INFORMATION

Smart Decisions

- Identify issues
- Prioritize
- Develop solutions
- Evaluate interventions

Analytical Challenges

Analytical Tools Must Support Development of --

- **Interventions that address *SYSTEM* issues, not just *OPERATOR* issues, and**
- **System interventions that**
  - **Are *SYSTEM-WIDE* in scope, and**
  - **Focus more extensively on *HUMAN FACTORS***

Aviation Information Success Story

65% Decrease in Fatal Commercial Aviation Crashes in 10 Years

Largely Attributed to

Proactive Safety Information Programs

P.S. Aviation was already considered ***VERY SAFE*** in 1997!!

“System Think” Success

Engage All Participants In The Process

- **Airlines**
- **Manufacturers**
  - *With the systemwide effort*
  - *With their own end users*
- **Labor**
  - *Pilots*
  - *Mechanics*
  - *Air traffic controllers*
- **Air Traffic Organizations**
- **Regulator(s)**

Manufacturer "System Think" Success

Aircraft Manufacturers are Increasingly Seeking Input, Throughout the Design Process, From

- ***Pilots*** **(*User* Friendly)**
- ***Mechanics*** **(*Maintenance* Friendly)**
- ***Air Traffic Controllers*** **(*System* Friendly)**

New Technology Success -- Eventually

- **Analysis of Flight Data Recorder Data**
  - **Excessive Ground Proximity Warning System (GPWS) events at certain airports**
- **Corrective Actions**
  - **Short-term:**
    - **FAA raised minimum vectoring altitudes and modified approach course**
    - **Modified approach procedures**
    - **Alerted pilots and controllers to problem**
  - **Long-term: Avionics manufacturer improved software**
- **Results**
  - **Eliminated "false" GPWS alerts at those airports**
  - ***Reduced GPWS complacency!!***

Moral:

Need *Rapid* Feedback When the System Is

– High-Tech

and

– Experiencing Rapid Technological Innovation

Failure: Inadequate Information

- **Strasbourg, France, 1992**
- **Risk Factors**
  - *Night, Mountainous Terrain*
  - *No Ground Radar*
  - *No Ground-Based Glideslope Guidance*
  - *No Airborne Terrain Alerting Equipment*
- **Very Sophisticated Autopilot**
- **Autopilot Mode Ambiguity**

Autopilot Mode Ambiguity

- **"3.2" in the window, *with a decimal*, means:**
  - **Descend at a *3.2 degree angle (about 700 fpm at 140 knots)***
- **"32" in the window, *without a decimal*, means:**
  - **Descend at *3200 fpm***
- **Clue: Quick Changes in Autopilot Mode Frequently Signal a Problem**
  - ***Flight data recorder readout program could have helped safety experts uncover this problem***

Failure:
Inadequate "System Think"

- **1995 – Cali, Colombia**
- **Risk Factors**
  - ***Night***
  - ***Airport in Deep Valley***
  - ***No Ground Radar***
  - ***Airborne Terrain Alerting***
    Limited to "Look-Down"
  - ***Last Minute Change in Approach***
    - ***More rapid descent (throttles idle, spoilers)***
    - ***Hurried reprogramming***
- **Navigation Radio Ambiguity**
- **Spoilers Do Not Retract With Power**

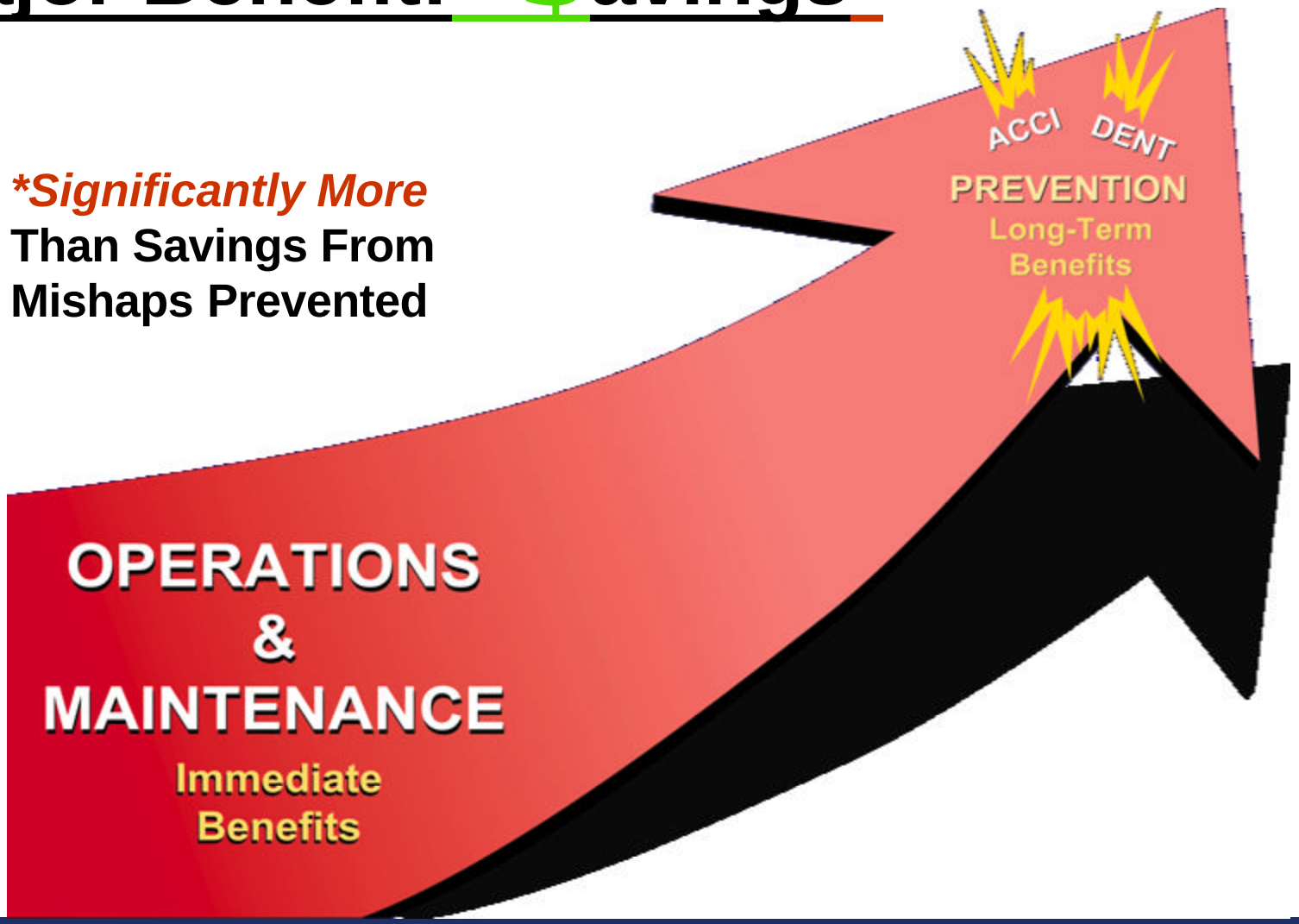
Recommended Remedies Include:

- **Operational**
  - ***Caution Re Last Minute Changes to the Approach***
- **Aircraft/Avionics**
  - **Enhanced Ground Proximity Warning System**
  - **Spoilers That Retract With Max Power**
  - **Require Confirmation of Non-Obvious Changes**
  - **Unused or Passed Waypoints Remain In View**
- **Infrastructure**
  - **Three-Letter Navigational Radio Identifiers**
  - **Ground-Based Radar**
  - **Improved Reporting of, and Acting Upon, Safety Issues**

Note: All but one of these eight remedies address system issues

Major Benefit: $avings*

**Significantly More*
Than Savings From Mishaps Prevented



But Then . . .

Why Are We

So Jaded in The Belief

That Improving Safety

Will Hurt The Bottom Line??

Costly Result$
Of Safety Improvements Poorly Done

Safety Poorly Done	Safety Well Done
1. Re-train/punish operator	Look beyond operator, to system problems

Poor workforce morale

Poor labor-management relations

Labor reluctant to tell management what's wrong

Retraining/learning curve of new employee if "perpetrator" moved or fired

Adverse impacts of equipment design ignored, problem may recur because manufacturers not part of remedies

Adverse impacts of procedures ignored, problem may recur because procedure originators (management, regulator) not part of remedies

Costly Result$
Of Safety Poorly Done (con't)

Safety Poorly Done	Safety Well Done
2. Management decides remedies unilaterally	**Workers engaged in identifying problems, developing remedies**
Problem may not be fixed	
Remedy may not be most effective	
Remedy may not be most cost effective	
Reluctance to develop and implement remedies due to past remedy failures	
Remedies less likely to address multiple problems	
3. Remedies based upon instinct, gut feeling	**Remedies based upon evidence**
Same costly results as No. 2, above	

Costly Result$
Of Safety Poorly Done (con't)

Safety Poorly Done	Safety Well Done
4. Implementation is last step	Evaluation after implementation

No measure of how well remedy worked (until next mishap)
No measure of unintended consequences

Bottom line:

- Safety implemented poorly can be very costly (and ineffective)

- Safety implemented well, in addition to improving safety, can also create benefits greater than the costs

Safety Plus Productivity Successes

- **Ground Proximity Warning Example**
  - ***S: Reduced warning system complacency***
  - ***P: Reduced unnecessary missed approaches, saved time and fuel***
- **Flap Overspeed**
  - ***S: Removed compromised airplanes***
  - ***P: Reduced need to take airplane off line for extensive disassembly, inspection, and reassembly***

Significant Opportunity

Bottom-Line Benefits From a
Well-Implemented Safety Information Program
Can Change the Situation From

"Another Safety Program
I Can't Afford"

To

$$$ A Profit Center $$$

Other Potential Benefits:

- **Better Labor Relations**

  - **Transforms workforce from brunt of blame when things go wrong, to valuable source of information about potential problems and how to remedy them, *i.e.,* converts labor and management from *Adversaries* to *Partners in Improvement***

- **Reduced Legal Exposure**

  - **Collecting, analyzing, and sharing will become industry standard for most, if not all, potentially hazardous endeavors; *woe to those who don't***

The Role of Leadership

- Demonstrate Safety Commitment . . . BUT

- Accept That Mistakes Will Happen

- Include "Us" (*e.g.*, System) Issues,

Not Just "You" (*e.g.*, Training) Issues

- Make Safety a Middle Management Metric

- Engage Labor Early

- Include the *System* --

Manufacturers, Operators, Regulator, and Others

- Encourage and Facilitate Reporting

- Provide *Feedback*

- Provide Adequate *Resources*

- *Follow Through* With Action

Thank You!!!

Questions?